CLAIMS

What is claimed is:

Sub A2

1. A saturable reflector apparatus comprising:
   a) a substrate having a first surface and a second surface; and
   b) a reflector attached to one of the first and second surfaces, wherein the reflector includes a saturable absorber layer;

   wherein at least one of the first and second surfaces has been modified to enhance an etalon effect of the substrate.

Sub C1

2. The apparatus of claim 1 wherein the modified surface has been polished.

3. The apparatus of claim 1 wherein the modified surface includes a coating.

4. The apparatus of claim 3 wherein the coating includes a metallic or a dielectric material.

Sub B27

5. The apparatus of claim 1, further comprising means for tuning the etalon effect.

Sub A3

6. The apparatus of claim 5 wherein the tuning means comprise means for adjusting an optical thickness between the front and back surfaces.

7. The apparatus of claim 6 wherein the adjusting means comprises a heat transfer element thermally coupled to the substrate, wherein the heat transfer element is chosen from the group consisting of heater elements and cooling elements.

Sub C1

8. The apparatus of claim 7, further comprising a temperature controller coupled to the heat transfer element.

9. The apparatus of claim 1, wherein the reflector includes a Bragg stack, whereby the saturable reflector is a saturable Bragg reflector (SBR).

10. The apparatus of claim 1 wherein the reflector includes a metal or dielectric film.

11. The apparatus of claim 1, wherein the substrate is between about 100 microns and 1000 microns thick.

Sub A5

Rule 1.126

~~8~~ 12. A method for tuning a Saturable Reflector comprising the steps of:

a) providing a substrate having a first surface and a second surface;

b) attaching a reflector with a saturable absorber layer to the first surface;

c) modifying at least one of the first and second surfaces to enhance an etalon effect of the substrate; and

d) using the etalon effect to control a spectrum of radiation reflected from the saturable reflector.

~~10~~ 13. The method of claim ~~8~~ 12 wherein the modifying step comprises polishing at least one of the front and back surfaces to within a quarter wavelength of light that will be used with the SBR.

~~11~~ 14. The method of claim ~~8~~ 12 wherein the modifying step comprises coating at least one of the front and back surfaces with a reflective coating.

~~12~~ 15. The method of claim ~~11~~ 14 wherein the coating includes a metallic or a dielectric material.

~~13~~ 16. The method of claim ~~9~~ 12, further comprising the step of tuning the etalon effect.

~~14~~ 17. The method of claim ~~13~~ 16 wherein the tuning step comprises adjusting an optical thickness between the first and second surfaces of the substrate.

~~15~~ 18. The method of claim ~~14~~ 17 wherein the thickness is adjusted by controlling a temperature of the substrate.

~~16~~ 19. The method of claim ~~13~~ 16, wherein the tuning adjusts a length of an optical pulse that is incident on the SBR.

~~17~~ 20. The method of claim ~~13~~ 16, wherein the tuning optimizes a relation between temporal and frequency domains of radiation incident on the SBR.

~~18~~ 21. The method of claim ~~13~~ 16 wherein the tuning adjusts a distribution of optical power amongst two or more modes of radiation incident on the saturable reflector.

~~19~~ 22. A laser comprising:
a) an optical cavity;
b) a lasing medium disposed within the optical cavity;
c) a pump configured to provide pump radiation to the lasing medium; and
d) a saturable reflector optically coupled to the cavity, wherein the saturable reflector includes

i) a substrate having a first surface and a second surface; and

ii) a reflector having a saturable absorber layer attached to one of the front and back surfaces; and

wherein at least one of the first and second surfaces has been modified to enhance an etalon effect of the substrate.

23 ~~20~~. The laser of claim 22 ~~19~~ further comprising a non-linear medium disposed within the cavity.

24 ~~21~~. The laser of claim 23 ~~20~~ wherein the nonlinear medium is a crystal containing a material chosen from the group consisting of Lithium Niobate ($LiNbO_3$), Lithium Tantalate ($LiTaO_3$), Lithium Borate ($LiBO_3$) periodically poled lithium niobate (PPLN), periodically poled lithium tantalate (PPLT) MgO:PPLN, KTP, PPKTP, RTA, BBO, MgO:LN, KTA, and PPRTA.

25 ~~24~~ ~~22~~. The laser of claim 22 ~~19~~ wherein the surface that has been modified to enhance the etalon effect has been polished.

26 ~~23~~. The laser of claim 22 ~~19~~ wherein the surface that has been modified includes a coating.

27 ~~24~~. The laser of claim 26 ~~23~~ wherein the coating includes a metallic or a dielectric material.

28 ~~27~~ ~~25~~. The laser of claim 22 ~~19~~, further comprising means for tuning the etalon effect.

29 ~~26~~. The laser of claim 28 ~~25~~ wherein the tuning means adjusts an optical thickness between the front and back surfaces of the substrate.

~~27~~ 30. The laser of claim ~~26~~ 29 wherein the adjusting means comprises a heater element thermally coupled to the substrate.

~~28~~ 31. The laser of claim ~~27~~ 30, further comprising a temperature controller coupled to the heater element.

~~29~~ 32. The laser of claim ~~19~~ 22 wherein the substrate has a thickness large enough such that the substrate acts as an etalon having a free spectral range of the same order as a linewidth of the laser.

~~30~~ 33. The laser of claim ~~29~~ 32 wherein the free spectral range is of order 1 GHz.

~~31~~ 34. The laser of claim 1 wherein the reflector is a Bragg stack, whereby the saturable reflector is a saturable Bragg reflector (SBR).

~~32~~ 35. The laser of claim 1, wherein the reflector includes a metallic or dielectric film.

~~33~~ 36. The laser of claim 1, wherein the substrate is between about 100 microns and 1000 microns thick.